

THE INNOVATION CATALYST



JULY 2023

IN THIS ISSUE:

- SBIR/STTR SMALL BUSINESS, RESEARCH TEAM GRANTS
- INVENTOR OF THE MONTH
- SCIENCE AND CLIMATE TOWN HALL
- SPAIN IS 25TH TO SIGN NASA'S ARTEMIS ACCORDS



»»» UPCOMING EVENTS:



- INNOVATOR HOUR
TUESDAY, JULY 11, 2023
1:00 - 2:00 P.M.
- COFFEE BREAK
Feat. SPO's Darryl Mitchell on Royalties
Tuesday, JULY 25, 2023
1:00 P.M. - 2:00 P.M.

TECH TRANSFER TIP

with Technology Transfer Expansion (T2X) Lead Samantha Kilgore:

As a part of our technology transfer mission, the Strategic Partnerships Office is committed to ensuring that innovations developed for exploration and discovery are broadly available to the public. Did you know that we have special programs such as the Technology Transfer Expansion (T2X) program dedicated to creating partnerships and reaching entrepreneurial audiences? The T2X Program works to accelerate the commercialization of NASA-developed technology by de-risking innovation and helping to launch startups.





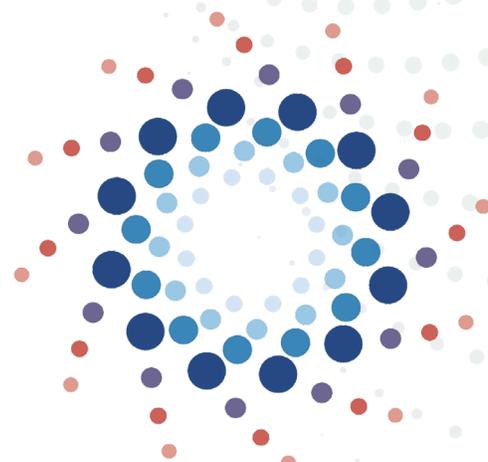
Earth observation taken during day pass by an Expedition 36 crew member on board the International Space Station (ISS). Per Twitter message: Simply Earth. Photo Credit: NASA / JSC

Unlocking Innovation

NASA Selects 300 Small Businesses and Research Teams for Technology Development through SBIR/STTR Grants

For many years, NASA has been seeking a reliable, efficient, and space-capable remote sensing technology that can be used in the areas of Earth sciences, planetary exploration, aviation safety, chemical and biological detection, and tactical imaging. 2pi Microwave Inc. believes it has come up with an answer.

The Milpitas, California-based firm has partnered with the University of Maryland in College Park, Maryland, to begin development of a lightweight, compact, and high-performance lidar system. The team believes that this technology will address a variety of NASA Goddard applications, including remote sensing of oceans and Earth's atmosphere, unmanned lander guidance and control, as well as real-time detection of atmospheric hazards. The 2pi Microwave-University of Maryland partnership is one of the many teams scheduled to receive a Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) grant of \$150,000 to demonstrate the merit and feasibility of their innovation.



SBIR • STTR
America's Seed Fund

To empower small businesses and research institutions to develop technologies that support NASA missions and benefit society, on June 5, NASA's Space Technology Mission Directorate (STMD) announced the award of

\$45 million in SBIR/STTR grants to 300 small business teams. Forty-two of those small businesses will receive SBIR/STTR grants totaling \$6.3 million that will directly support Goddard missions, flight projects, and research. The 2pi Microwave-University of Maryland partnership received a STTR grant.

This year, NASA selected proposals from 249 small businesses, 39 research institutions, and 12 Minority Serving Institutions (MSIs) for first-round, Phase I SBIR/STTR funding. MSIs are institutions of higher education that serve minority populations. The Phase I SBIR contracts are awarded to small businesses and will last for six months. The Phase I STTR contracts are awarded to small businesses in partnership with a research institution and will last for 13 months.

“NASA has a key role to play in growing the aerospace ecosystem in our country,” said Jenn Gustetic, director of Early-Stage Innovation and Partnerships for NASA’s STMD. “Through these early-stage small business awards, we are inviting more innovators into this growing arena and helping them mature their technologies for not only NASA’s use, but for commercial impact.”

NASA’s SBIR/STTR programs funds the research, development, and demonstration of innovative technologies that fulfill NASA needs as described in its annual solicitations and are deemed to have significant potential for successful commercialization. To be eligible for a Phase I SBIR/STTR grant, businesses are defined by NASA as to either have 500 or fewer employees or be a non-profit research institution such as a university or a research laboratory.

“We are proud to work alongside the small businesses and research institutions in need of government investment,” said Gynelle Steele, deputy program executive for NASA’s SBIR/STTR program. “This program enables NASA to nurture pioneering ideas from a diversity of innovators across the country that may not attract the initial private industry funding needed to thrive.”

Based on their progress during Phase I, companies may submit proposals for up to \$850,000 in Phase II funding to develop a prototype, as well as subsequent SBIR/STTR Post Phase II to further nurture development of technologies for transition into NASA programs, other government agencies, or the private sector.

“Phase I awards are just the beginning,” explained SPO’s Joe Famiglietti SBIR/STTR center lead at Goddard. “Small businesses can use SBIR/STTR Phase III Contracts to meet their project’s goals. This streamlined process meets the Sole Source Requirement ensuring deadlines are met. A Phase III contract can be awarded at any time, for any dollar amount and duration of a past or currently awarded Phase I or Phase II contract from any government agency.”

This year, more than a quarter of the selected companies for SBIR/STTR funding are women-owned, veteran-owned, disadvantaged, and/or HUBzone small businesses. The U.S. Small Business Administration defines HUBzone as small businesses that are in historically underutilized business zones.

In addition, four of this year’s STTR awardees previously received NASA M-STTR (Minority) planning grants, which are now part of Minority University Research and Education Project Partnership Annual Notification (MPLAN). M-STTR was created to incentivize partnerships between MSIs and small businesses. Now part of MPLAN, NASA provides expert guidance and resources throughout the program, enabling MSIs to help deliver technological innovations that contribute to NASA’s missions.

“These [SBIR/STTR] grants provide funding and mentorship to stimulate creative engagements between MSIs and small businesses and help spur mutually beneficial relationships that result in technologies supporting NASA mission and commercial market development,” said Steele. “We are pleased that MPLAN continues to help increase the number of skilled research teams that are better prepared to take their ideas from lab to market and strengthen the STTR program through their contribution.”

For more information about NASA’s SBIR and STTR program, please visit, <https://sbir.nasa.gov/>.



Inventor of the Month



Goddard Researcher Brings Artificial Intelligence to NASA

A few days after SpaceX launched 21 V2 satellites into space on February 27, Elon Musk announced on Twitter that the new satellites were “experiencing some issues.” While Musk did not further specify the problem, he later tweeted, “Some [satellites] will be deorbited, others will be tested thoroughly before raising altitude above [the] Space Station.”

Satellites in space can experience disruption and degradation for several reasons, ranging from other objects in orbit and natural space weather phenomenon to electrical faults. These in-orbit events can quickly translate into degraded services in spacecraft applications. Users on the ground are likely to see tangible impacts, the severity of which will vary depending on the use case involved.

As a satellite requires consistent and reliable contact with Earth ground stations to transmit collected data, disruption to a communication service on a satellite can have significant impacts. Positioning signals support navigation systems such as Global Positioning System. If disrupted, satellites can be left blind.

When something goes wrong on a spacecraft while in orbit, ground controllers must diagnose the problem from a vast distance on Earth. Additionally, it could take ground controllers days to find out what is wrong and even more time to fix the problem. During this period, a satellite will usually go into “safe mode” to save energy and thus stop collecting data or otherwise perform its mission.

Using Artificial Intelligence (AI), Dr. Evana Gizzi, an artificial intelligence researcher with NASA Goddard’s Science Data Processing Branch (Code 578) is developing a software system that can be integrated into a spacecraft’s bus – or necessary components of the satellite – that in real time, can diagnose a problem that goes wrong while in orbit. Using a combination of next-generation autonomous methods, such as Kalman Filters, Autoencoders, and Causality algorithms, the yet unnamed AI platform, will essentially go under the hood of the spacecraft and automatically diagnose what is wrong with the satellite. Knowing what has gone wrong is the first phase of addressing the problem.



Dr. Evana Gizzi, Photo Credit: Sergio Alonso Photography



continued from page 4

NASA simply defines AI as “the simulation of human decision-making capabilities in machines.” According to IBM, AI is defined as a “combination of computer science and robust datasets, to enable problem-solving, including the sub-field of machine learning.” Gizzi said she further defines AI “as the ability of a computer or computer-controlled robot with the ability to learn, to reason and learn from past experiences, and to perform tasks commonly associated with humans.”

“Artificial intelligence is very new to NASA Goddard,” explained Gizzi, who first began working on the AI software platform when she was a NASA Pathways intern in 2018. “The idea behind what we are trying to do is: when a problem happens onboard a spacecraft, our AI platform is able to diagnosis the problem without any kind of ground control intervention. What is unique about our AI platform is that it will do it autonomously.”

“Our reporting fault [maintenance concept that increases operational availability and that reduces operating cost] in the AI software is like your car’s engine light going on,” continued Gizzi, “We assume that when the warning light goes on there is a problem and if we can find the cause, then we can fix it. But what if it is something that we have never seen before. That is where the AI algorithm comes in, using machine learning and classic AI techniques, it will be able to diagnose the cause of the problem.”

According to Gizzi, the automated fault diagnostic systems now used on spacecrafts rely on a combination of physics and problems that engineers and scientists are already aware of. It cannot figure out what to do in unexpected fault cases. Meaning the spacecraft simply knows that if A happens, it can only respond by doing B.

“Typically,” explained Gizzi, “an automated fault diagnostic system on a spacecraft develops a ‘logic tree’ ahead of time. For example, if the temperature is above 70 degrees the computer will do this, if it is below 70 degrees it will do that. The problem with this kind of diagnostic is that you have to consider what might happen. When something happens that no one expected at all and it does not fit the ‘logic tree,’ then that is something the fault diagnostic system cannot handle. Using AI, our system can handle things that do not fit in that ‘tree.’ That is a huge reason why we have moved to AI.”

Gizzi said that she and her team have built the AI software platform. She noted that it is in Technology Readiness Level 4, where they have successfully tested it in Goddard laboratories using a Raspberry Pi or small single-board computer. The next step, she said, is to field test it on a CubeSat. “Now that we have developed the software to diagnose the spacecraft’s problem,” she said, “we are working on the AI platform to fix problem as well, so it becomes a self-healing satellite.”

Gizzi has submitted the AI software for a New Technology Report (NTR) with Goddard’s Strategic Partnership Office (SPO), which potentially will be licensed and patented. Because she believes the AI system has commercial potential beyond space-based applications, she is planning to submit another NTR for a separate piece of AI technology software with SPO. “I am thinking of establishing a partnership with academic universities in the US,” she said, “So they can do research on it.”



Town Hall at Goddard Space Flight Center, Photo Credit: NASA / GSFC

No Place Like Home

NASA Town Hall Focuses on Understanding Climate Change and What Employees Can Do to Save the Planet

In response to NASA's first Climate Summit in 2022, which highlighted the agency's climate research findings, the agency is holding a series of town hall meetings across all of its centers to further inform the workforce of its climate initiatives. Additionally, these meetings demonstrate how these efforts are connected to the work that is happening throughout NASA, including Goddard's Strategic Partnership Office. On June 8, Goddard Center Director Dr. Makenzie Lystrup served as host and facilitator of a panel discussion and Q&A Science and Climate Town Hall with Goddard employees, explaining the current state of climate change, what NASA is doing, and what they can do to support NASA's science and climate goals. Goddard was the first center to hold a climate-centered town hall.



NASA Deputy Administrator Pam Melroy speaks, Photo Credit: NASA / GSFC

Lystrup was joined onstage by NASA Deputy Administrator Pam Melroy, who delivered opening remarks and served as a panelist. Other panelists included, NASA Chief Scientist and Senior Climate Advisor Kate Calvin, NASA Director of Earth Science Karen St. Germain, Goddard Director of Sciences and Exploration Christa Peters-Lidard, and Goddard Director of Earth Sciences Dalia Kirschbaum.

"Earth and climate science are really top priorities for NASA and also for the Goddard Space Flight Center," said Lystrup at the introduction. "About half of the science portfolio at Goddard is dedicated to Earth sciences and that is a huge piece of the work that we do on campus and our other [Goddard] sites. But I think what we are really looking at is understanding how our planet is changing over time."

Lystrup used Goddard's Global Modeling and Assimilation Office (GMAO) as an illustration, stating that it serves



Attendees applaud at GSFC Town Hall, Photo Credit: NASA / GSFC

continued from page 6

NASA's Earth Science mission by optimizing the impact of satellite data through assessments and forecasts of the Earth's atmosphere, ocean, land, and cryosphere. "GMAO helps us better understand changes of Earth throughout time and continuously improves our weather forecasting models used by NOAA [National Oceanic and Atmospheric Administration] and others," she said.

"Understanding our changing climate is a priority for the [Biden] administration and it is a priority for NASA Administrator Bill Nelson and for me as well," explained Melroy. "And Goddard is central to contributing in major ways to that understanding. If you want to unpack that, people think we are a space agency that does aeronautics and sometimes they don't fully understand what our role is. So, I would like to explain that NASA studies Earth as a planet. NASA is collecting and modeling space-based climate data and then we enable a very broad science community to be able to generate climate information."

"As the next step," she continued, "NASA partners at all levels – with local, tribal, state, federal and international organizations – to help end users understand how to use that data. NASA does that by]taking advantage of the unique point from space. There is a lot of science that we can only do from space. The James Webb Space Telescope is an example. It is impossible to really understand at scale what is happening with Earth's system, we have to do it from space."

As a global leader in studying Earth's changing climate, Melroy explained how NASA observations of Earth from space, the air, and on the ground are helping scientists learn how the interconnected systems of our planet interact. Goddard, she added, has a broad climate research program. She noted that the many areas Goddard studies include solar activity, sea level rise, the temperature of the atmosphere and ocean, the health of the ozone layer, air pollution, and changes in sea and land ice.

"What that means," Melroy said, "is we are taking advantage of our enormous collection of satellites, but also using the International Space Station to study the Earth as well. NASA provides the bulk of the data to decision makers to understand what is happening with climate and we are able to do that in a very cost-effective way. We partner with others and share the data. That is what is really magic about NASA."

One of the key points that Melroy made at the town hall is that climate data is not like collecting information for a weather forecast. "Everybody knows how to use a weather forecast for gaining hurricane preparedness information

continued from page 7

from FEMA [Federal Emergency Management Agency], but climate data is different," she stressed. "The weather forecast from last week is not very important because it is already past. We need to be cataloging that climate data and adding it into our models. It is a much more complex problem, and we need to continue to evolve our understanding of climate."

At the town hall, Melroy also announced that NASA will be opening the Earth Information Center at the agency's headquarters location in Washington D.C. at the end of June. Conceived in September 2022, the Earth Information Center is an interactive visual display of readily usable and easily accessible climate data collected from several federal agencies. The center will showcase large visualizations, interactive stories, and narratives, which will focus on sea level rise and coastal impacts, health and air quality, wildfires, greenhouse gas emissions, energy and power for efficient communities, and agriculture productivity.

After Lystrup and Melroy explained to the audience what NASA is doing to study climate, Calvin then described how she is disseminating that climate portfolio information agency wide. One of the goals of NASA's Climate Summit in December 2022, she said, was communicating to the workforce what the agency is doing and where NASA will go from here. "What we heard from the questions that we got [afterwards], is that employees wanted more information about what we are doing, and they wanted more agency-wide collaboration," said Calvin. "People have questions about what is happening at their centers. This town hall is designed to engage the workforce and to continue conversations about climate."

To help employees and the public understand what NASA is doing to combat climate change and provide a roadmap to future agency endeavors, Calvin said NASA released a "Advancing NASA's Climate Strategy" paper on March 29, 2023. Written by a cross-agency working group through NASA's Office of the Chief Scientist, the strategy document assessed NASA's climate portfolio across the agency, including every mission directorate and NASA facility. The strategy lays out four key priorities (innovate, inform, inspire, and partner) for the agency to aide with the integration of climate across NASA.

"The climate and Earth system are changing, and this impacts not only what science we need, but also how we think about our operations and mission safety," said Calvin. "This strategy will help NASA integrate our understanding of climate across the agency and in our partnerships to better serve the public. The climate strategy is not only looking at what we are doing now but also looks at opportunities for the future."

A key element of the strategy, added St. Germain, is the key role that partnering across agencies, institutions, and industries plays in understanding how NASA is responding to climate change. The strategy outlines how NASA will continue to coordinate external and internal partnerships to deliver actionable climate information to stakeholders ensuring the broadest applicability of NASA climate information and technologies.

"NASA's decades-long and vast array of Earth, atmospheric, and solar data have long been one of the foundations of how we understand climate and the Earth system," said St. Germain. "By studying Earth as a system – from a variety of viewpoints and through many different instruments and scientific fields – NASA's integrated approach is key for better understanding our home planet. And understanding it gives us the means to better protect it."

"We are really at a pivot point," said Melroy in conclusion. "We've learned a lot from all the missions that NASA has been doing, but we are ready to take the next step. It's incredibly urgent to act because climate change is accelerating and the impacts seem to be increasing, so NASA's role has never been more important. But we need to develop actionable solutions that we can measure and see what impact they are having. Any mitigation steps that you take, you have to stop and see if it is successful. For that, continuous measurement is critical."



Photo Credit: NASA / GSFC

THE STRATEGIC PARTNERSHIPS OFFICE (SPO) PRESENTS



THE COFFEE BREAK



Photo Credit: Samantha Kilgore

Featuring SPO's Darryl Mitchell on Royalties

Are you developing Goddard technologies?

Do you have innovative ideas?

If you answered "yes" to either question, then this coffee break with SPO's Office Chief Darryl Mitchell featuring royalties is for you.

Bring your questions, too!

TUESDAY, JULY 25, 2023

1:00 P.M.-2:00 P.M.

VIRTUAL EVENT

How to Sign Up

To RSVP for the upcoming Coffee Break,
[complete the sign-up form](#)



(From left): Julissa Reynoso, the U.S. Ambassador to Spain and Andorra, NASA Administrator Bill Nelson and Pedro Sánchez, President of Spain, witness Diana Morant, Spain's science and innovation minister, sign the Artemis Accords. Photo Credits: NASA/Jackie McGuinness

Spain Becomes 25th Country to Sign NASA's Artemis Accords

On May 30, Spain became the 25th country to sign the agency's Artemis Accords, a set of rules that govern international space exploration. This is an indication that NASA's Artemis mission to send people back to the Moon and beyond has genuinely become an international undertaking. Drafted by NASA, and the U.S. Department of State, the non-binding multilateral agreement establishes a framework for cooperation between nations for the peaceful use of the Moon, Mars, and other astronomical objects. The agreement highlighted the continued scientific cooperation between the U.S. and Spain.

"¡A la Luna y más allá! [To the Moon and beyond]," tweeted NASA Administrator Bill Nelson from the signing ceremony at Madrid's Moncloa Place. "I was honored to join President Pedro Sánchez, Science and Innovation Minister Diana Morant, and U.S. Ambassador Julissa Reynoso Pantaleón today in Madrid as Spain became the 25th nation to sign the Artemis Accords. We are united by the promise of space exploration—juntos [together]."

"Space is an example of international collaboration and a priority for our country's vision," Sanchez said in a statement. "We are witnessing a commitment by the government of Spain to a key sector that generates opportunities and high-quality employment, which is a priority and strategic area, essential to helping and protecting our society."

The original signatories of the Accords include Australia, Canada, Italy, Japan, Luxembourg, the United Arab Emirates, the United Kingdom, and the United States. Additional signatories include the Ukraine, South Korea, New Zealand, Brazil, Poland, Mexico, Israel, Romania, Singapore, Columbia, France, Saudi Arabia, Rwanda, Nigeria, Bahrain, the Czech Republic, and now Spain.



NASA Administrator Bill Nelson (left) meets with Spanish President Pedro Sánchez May 30 as part of the signing ceremony for Spain joining the Artemis Accords. Photo Credit: Moncloa Palace

continued from page 10

Through NASA's Artemis program, the next era of space exploration is underway to send the first woman and minority to the lunar surface of the Moon by the end of 2025. Artemis is already driving new technology development at Goddard to fulfil NASA's mission. With the help of the Strategic Partnership Office, many of those new technologies are likely to have commercial potential and be utilized by private industry and academia.

While NASA is leading the Artemis program, international partnerships will play a key role in achieving sustainable and robust presence on the Moon, where the agency will prepare for the first human mission on Mars. The question that the Artemis Accords seeks to answer is what happens when international dynamics and politics come into play.

The Artemis Accords are a set of declarations that outline common principles, guidelines, and best practices that are applicable to the safe exploration of the Moon and eventually beyond as humanity lengthens the duration of space missions to reach Mars. They were initially signed by eight nations on October 13, 2020. The Accords are based on several principles including peace, transparency, interoperability, emergency assistance, and minimizing resource conflict.

One of the key principles of the Artemis Accords is to affirm the importance of countries complying with the 1967 Outer Space Treaty. This multilateral treaty forms the basis of international law on the use of outer space, including most importantly, prohibiting the use of nuclear weapons in space. Additionally, the Accords affirm the importance of the Rescue and Return Agreement signed in 1968, which emphasizes the responsibility of nations to safely return astronauts and equipment to Earth. It also includes other space-related policies such as the 1972 Liability Convention and the 1975 Registration Convention, which make countries liable to pay compensation for damage caused by its spacecraft.

For years, Spain has been a major contributor to the European Space Agency, but recently it has been working to bolster its own space presence. In 2021, Spain announced it would establish the Agencia Especial Española, which officially became operational earlier this year. The agency is working with PLD Space, a Spanish aerospace firm to launch two vehicles, Miura 1 and Miura 5, which are being developed to perform research in the microgravity environment in Earth's upper atmosphere.

The signing of the Accords agreement follows Sanchez's trip to Washington, D.C., on May 12, during which time he met with President Joe Biden and discussed the strengthening of scientific cooperation between their two nations. At the White House meeting, the two presidents pledged to deepen cooperation in science and technology, including through the Artemis Accords.

"The United States and Spain's partnership in space has been on display for decades, but today we bring it to new heights," said Nelson in a statement. "As the newest member of the Artemis Accords family, Spain will safeguard our shared ideals by helping ensure that humanity's rapid expansion into space is done peacefully, safely and transparently."

THE STRATEGIC PARTNERSHIPS OFFICE (SPO) PRESENTS

INNOVATOR HOUR

Have questions about protecting your innovation?

Want to learn more about how to submit New Technology Reports?

Have general questions about technology transfer and partnerships?

Sign up for a one-on-one 20-minute timeslot with a SPO representative.

Meetings will be held virtually via Microsoft Teams.

NEXT SESSION: TUESDAY, JULY 11, 2023
1:00-2:00 P.M.

Available Timeslots

1:00-1:20 P.M.

1:20-1:40 P.M.

1:40-2:00 P.M.

How to Sign Up

To register for the upcoming session and secure your timeslot,
[complete the registration form.](#)